Non-Traditional Sources of Per- and Polyfluoroalkyl Substances (PFAS)

FIFTH INTERNATIONAL SYMPOSIUM ON BIOREMEDIATION AND SUSTAINABLE ENVIRONMENTAL TECHNOLOGIES

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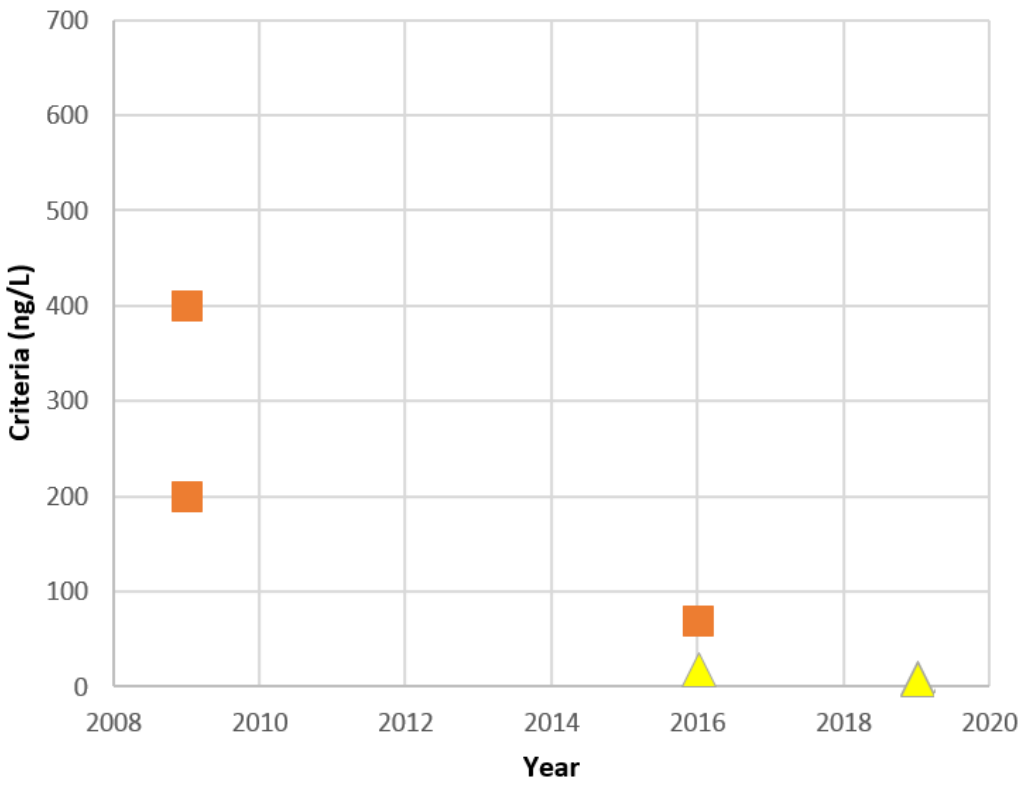
Outline

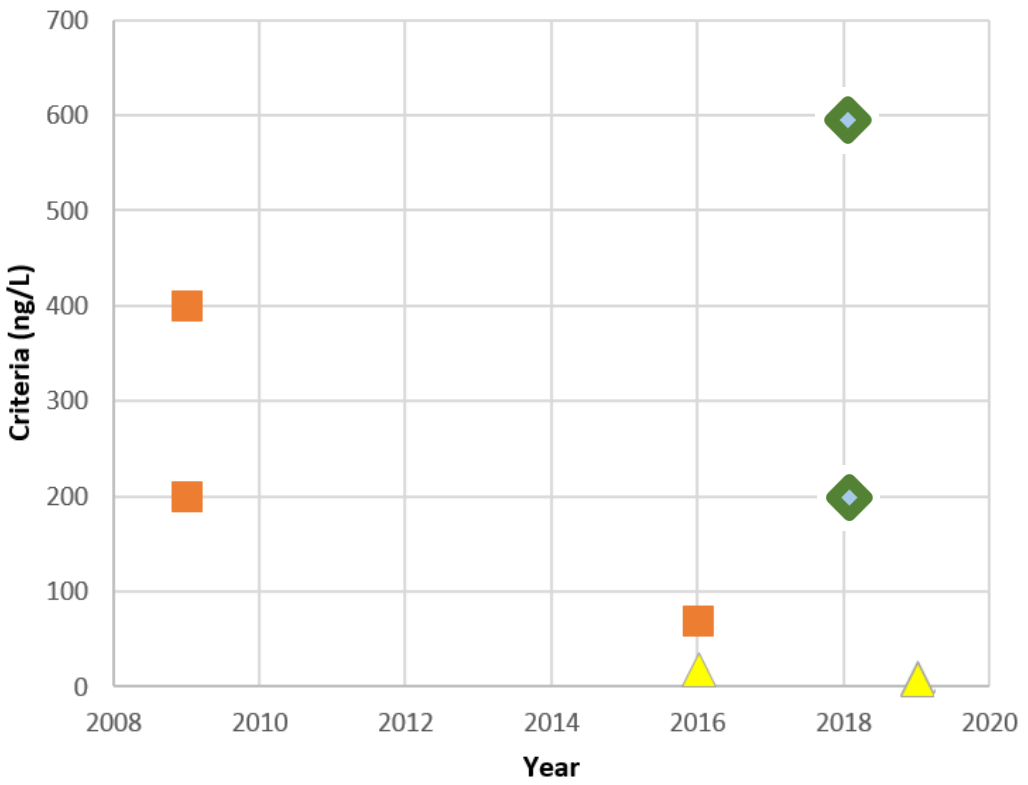
- Regulatory Trajectory
- Traditional and Emerging Sources
- Regional PFAS Investigations
- Case studies
  - Rural Schools
  - Car wash
  - Granite finishing
  - Residential Wells
- Source Differentiation
- Findings

Regulatory Trajectory



- USEPA Advisories
  - 2009 Provisional Health Advisories for PFOA and PFOS (400 ppt for PFOA and 200 ppt for PFOS).
  - 2016 – Published a Lifetime Health Advisory of 70 ppt for PFOA and/or PFOS.
- State standards
  - 2016 Vermont standard of 20 ppt
  - 2019 Michigan standards of 8-9ppt
  - 2019 New Jersey interim groundwater quality standard - 10 ppt

Regulatory Trajectory



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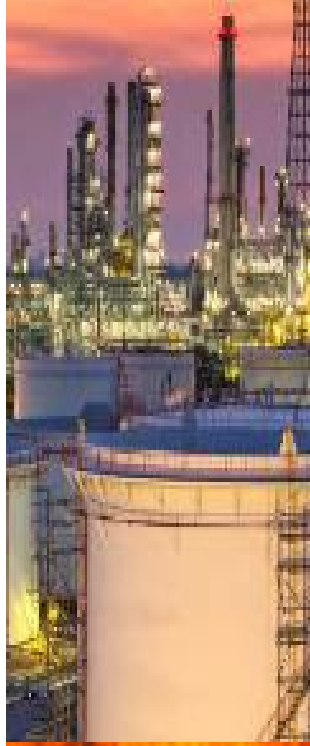
- State standards
  - 2016 Vermont standard of 20 ppt
  - 2019 Michigan standards of 8-9ppt
  - 2019 New Jersey interim groundwater quality standard - 10 ppt
- Recent international standards
  - 2018 Canadian screening values of 200 ppt PFOA, 600 ppt PFOS

*Public/NGO pressures attempting to drive state standards even lower

PFAS Sources

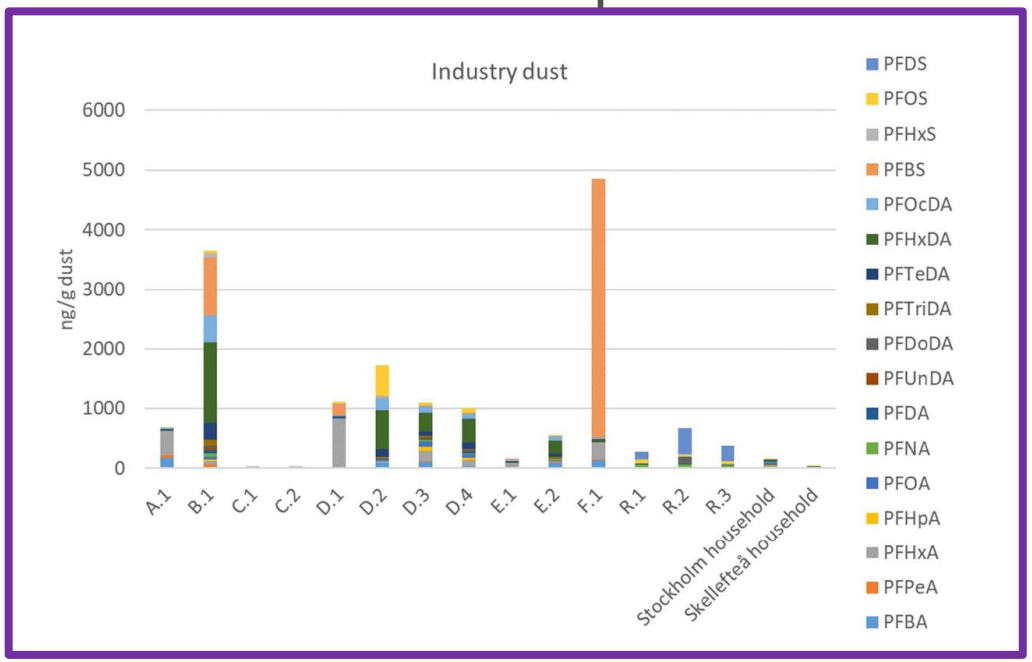
- Traditional Sources
  - Firefighting facilities
  - Manufacturing facilities
  - Landfills
  - WWTPs
  - Biosolids
- Emerging Sources
  - Manufacturers unknowingly using PFAS
  - Car washes
  - Junkyards
  - Granite/stone cutting/sealing facilities
  - Carpet cleaning facilities, automotive detailing
  - Septic systems
  - AFFF use outside of training/fuel fires



Manufacturing

MANUFACTURERS UNKNOWINGLY USING PFAS

- Scandinavian study – investigating potential sources of elevated PFAS levels in blood
- Manufacturers indicated PFAS were not used
- Industrial dust samples collected



#	Industry	Employed
A.1	Wood	10
B.1	Paint	10
C.1	Metal	30
C.2	Metal	30
D.1	Rubber	210
D.2	Rubber	210
D.3	Rubber	210
D.4	Rubber	210
E.1	Wood	107
E.2	Wood	107
F.1	Plastic	20

Source: Weiss et al, 2019

Residential/Commercial Sources of PFAS

Table 6-1. Comparison of source strengths for total amount of PFCA (TPFCA) in a hypothetical, "typical" American home [a]

Group ID	Article category	TPFCA in article	Article quantity [b]	TPFCA in home (mg)
A	Pre-treated carpeting [c]	48.4 ng/cm^2	150 m^2	72.6
B	Commercial carpet-care liquids	12000 ng/g	6 kg [d]	71.8
C	Household carpet/fabric-care liquids and foams	953 ng/g	1 kg	0.95
D	Treated apparel	198 ng/g	2 kg	0.40
E	Treated home textile and upholstery	336 ng/g	5 kg	1.68
F	Treated non-woven medical garments	795 ng/g	0 kg	0
G	Treated floor waxes and stone/tile/wood sealants	2430 ng/g	1 kg	2.42
H	Treated food contact paper	3100 ng/g	0.01 kg	0.03
I	Membranes for apparel	124 ng/g	1 kg	0.12
J	Thread seal tapes and pastes	603 ng/g	0.02 kg	0.01
K	Non-stick cookware	0.028 ng/cm^2	1 m^2	0.0003
L	Dental floss and plaque removers	31.3 ng/g	0.005 kg	0.0002
M	Miscellaneous	69.5 ng/g	0	0

Source: EPA, 2009

Carpet Care Liquids

Total PFCA in "average" house from carpet care liquids = 71,800,000 ng

C8 (aka PFOA) in house = 11,000,000 ng

Potential volume of water with C8 > 70 ng/L = 41,800 gallons

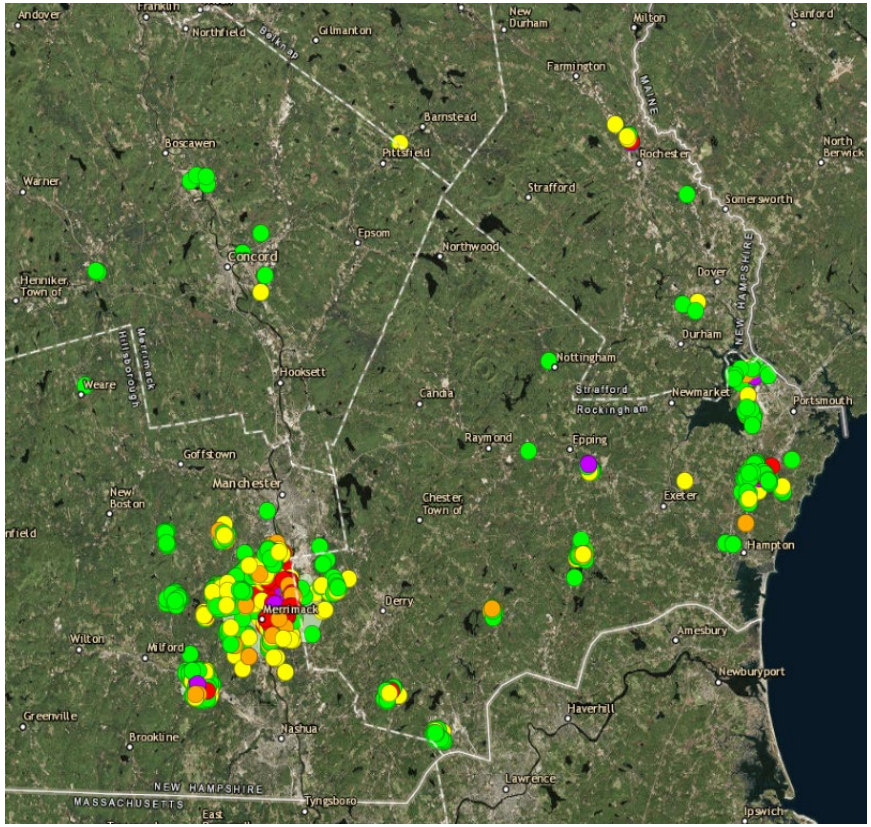
Regional PFAS Investigations

SOUTHEASTERN NEW HAMPSHIRE

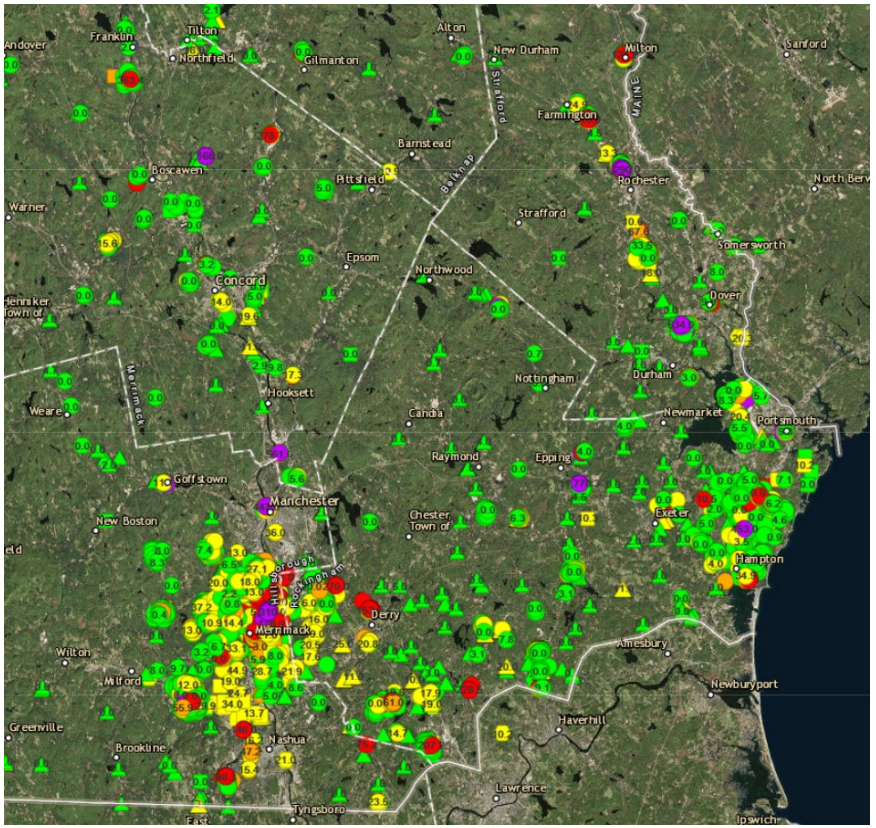
PFOA+PFOS (ppt)

- 400+ ppt
- 70 ppt - <399 ppt
- 45 ppt - <70 ppt
- 10 ppt - <45 ppt
- <10 ppt

2017



2019



Source: http://nhdes.maps.arcgis.com/apps/View/index.html?appid=66770bef141c43a98a445c54a17720e2

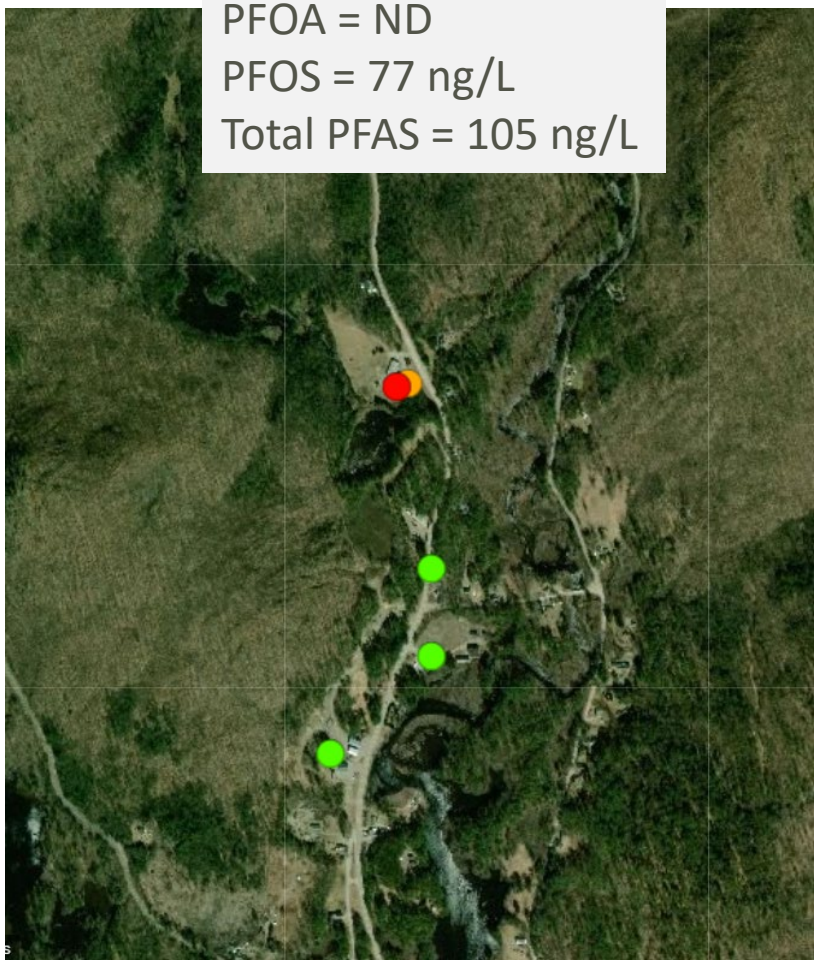
PFAS and Rural Schools

- Vermont
  - Sampled 10 rural school wells with bedrock supply wells and septic systems
  - 2 of 10 wells had PFAS concentrations above the 20 ppt health advisory
- New Hampshire
  - One rural school PWS with PFOS above the NH standard of 70 ppt
  - Several rural school PWSs in NH had PFAS concentrations above Vermont's 20 ppt health advisory

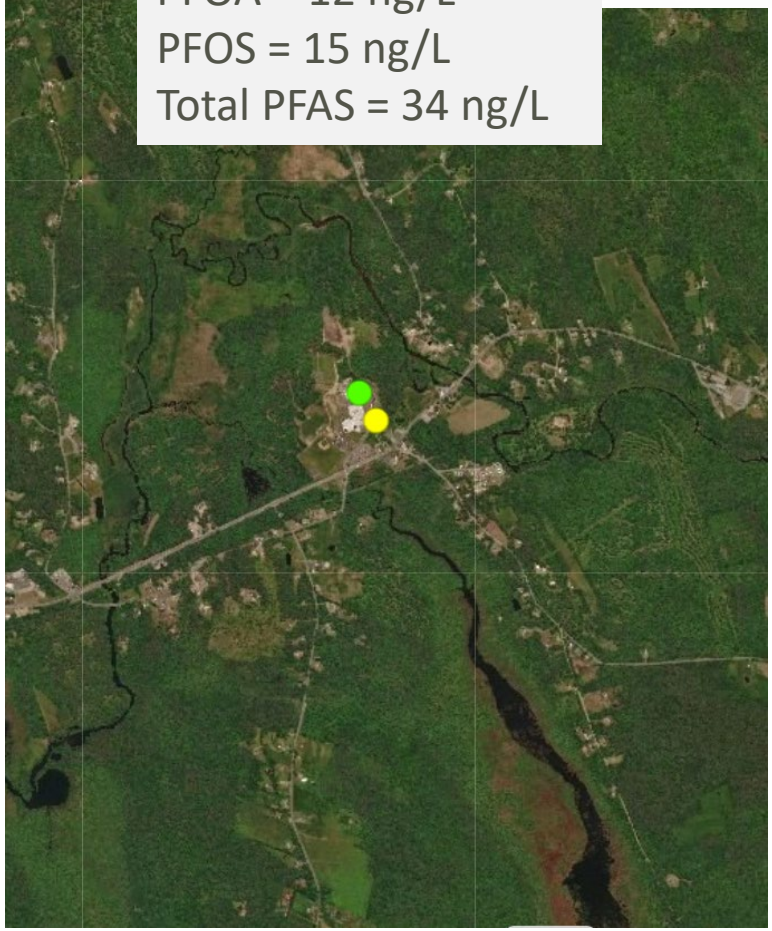
Rural School Examples

NEW HAMPSHIRE SCHOOLS

PFOA = ND
PFOS = 77 ng/L
Total PFAS = 105 ng/L



PFOA = 12 ng/L
PFOS = 15 ng/L
Total PFAS = 34 ng/L



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Rural School Example

PFOA+PFOS (ppt)
- 400+ ppt
- 70 ppt - <399 ppt
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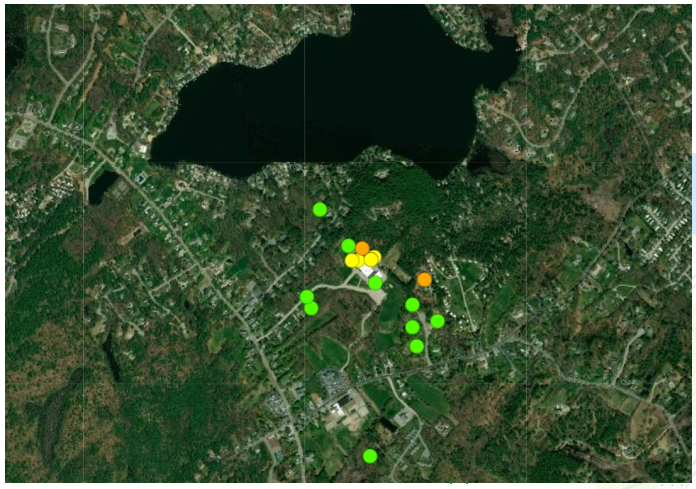
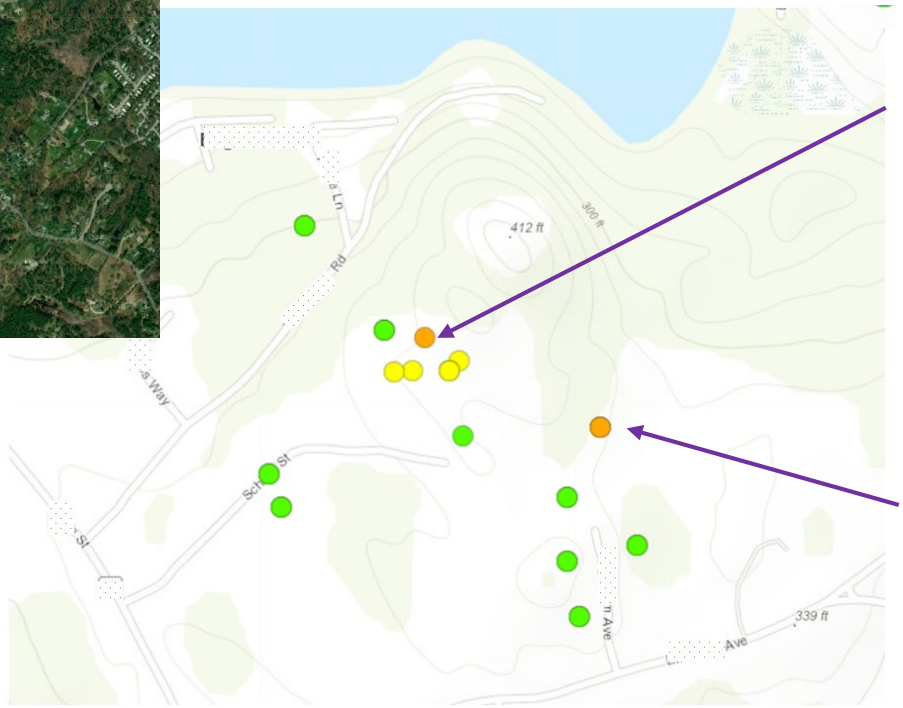
- <10 ppt





PFOA = 24 ng/L
PFOS = 23 ng/L
Total PFAS = 107 ng/L

PFOA = 21 ng/L
PFOS = 30 ng/L
Total PFAS = 113 ng/L

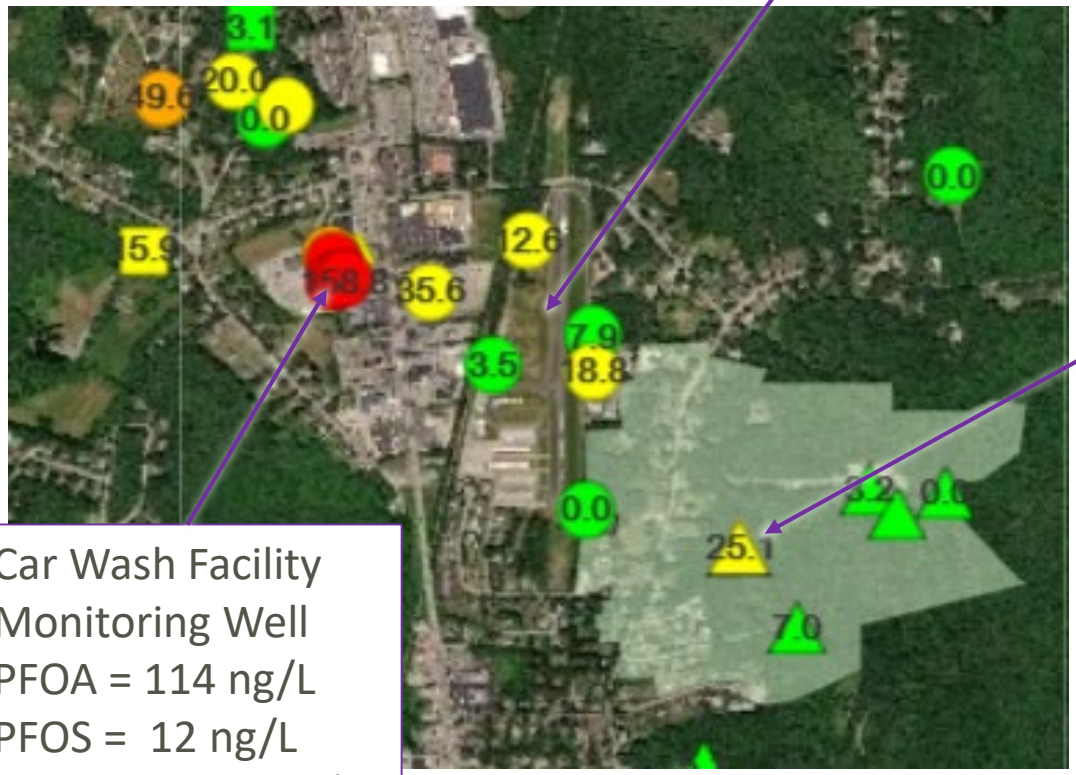
Car Wash Example

EXAMPLE OF COMMERCIAL/RESIDENTIAL PFAS IMPACTS

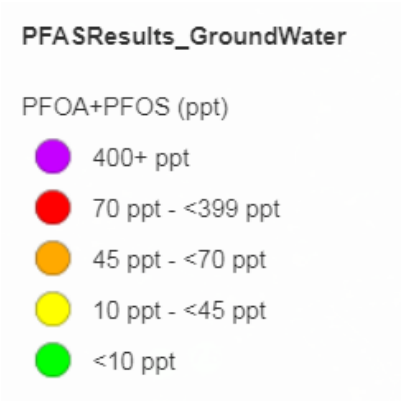
Airport

Public Water Supply Well
PFOA = 20 ng/L
PFOS = 5 ng/L

Shorter chain carboxylates detected at higher concentrations than PFOA



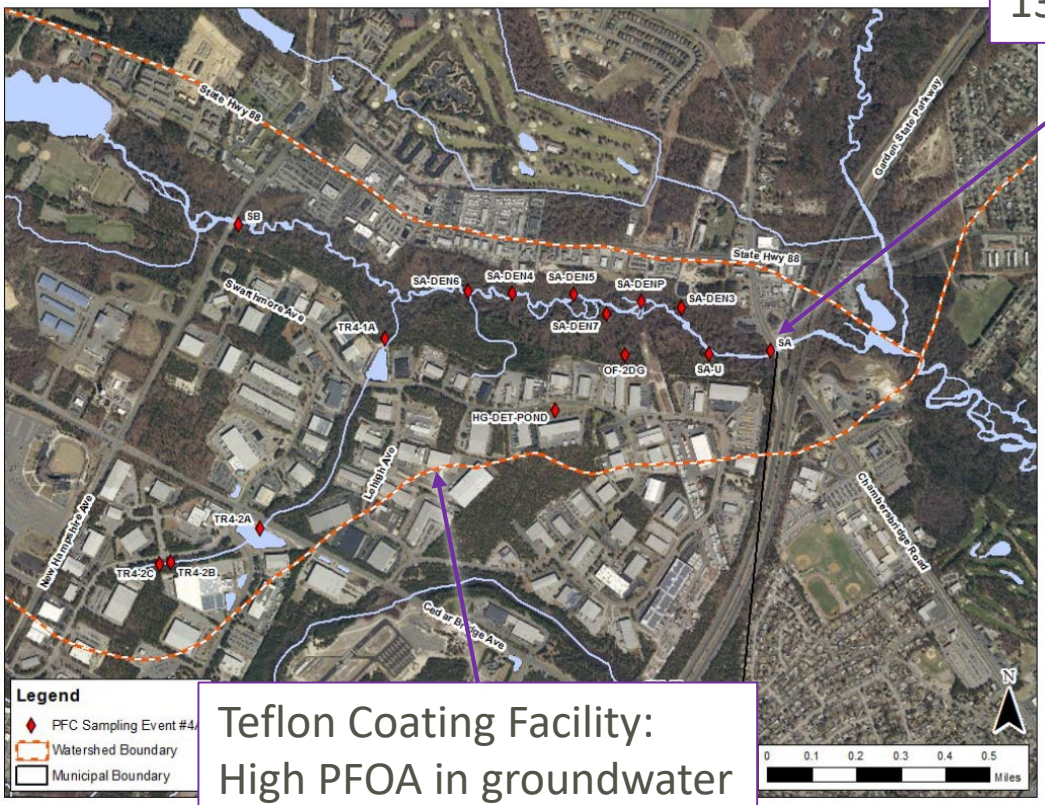
Car Wash Facility Monitoring Well
PFOA = 114 ng/L
PFOS = 12 ng/L
PFHxA = 3040 ng/L
PFPeA = 2050 ng/L



Graphic Source: http://nhdes.maps.arcgis.com/apps/View/index.html?appid=66770bef141c43a98a445c54a17720e2

Granite Processing Facility Example

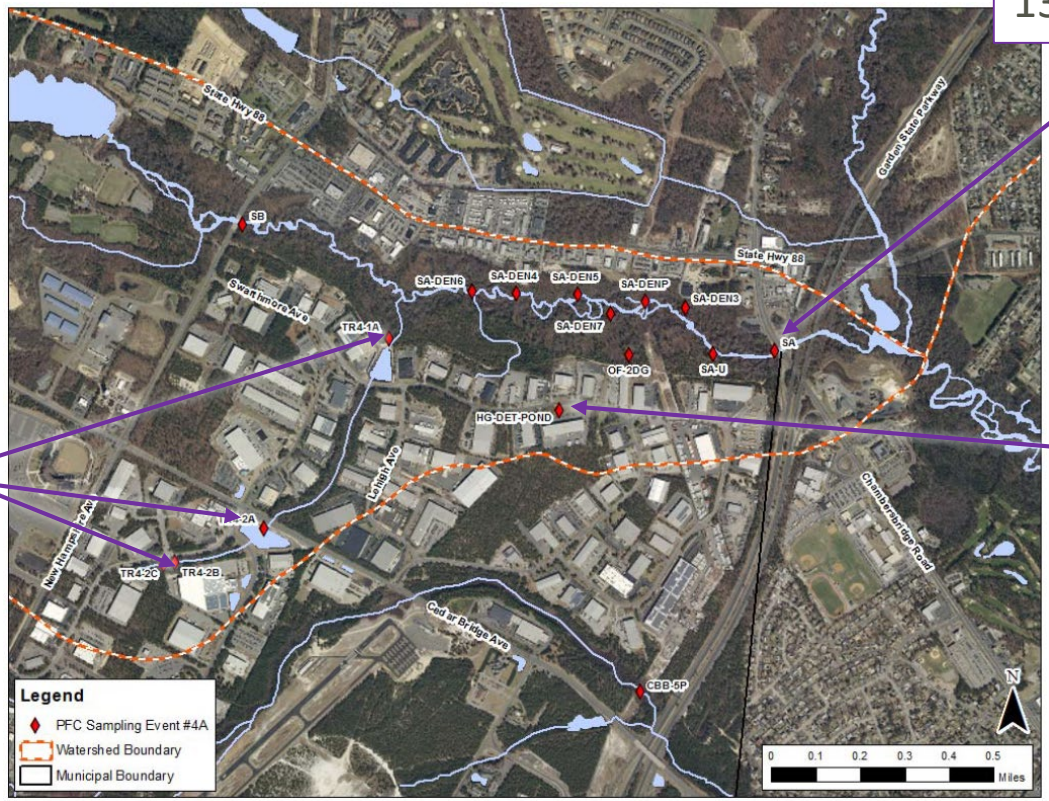
Main Stream Surface water samples: PFOA up to 130 ng/L



Teflon Coating Facility: High PFOA in groundwater – identified as “source” in 2015

Granite Processing Facility Example

Main Stream Surface water samples: PFOA up to 130 ng/L



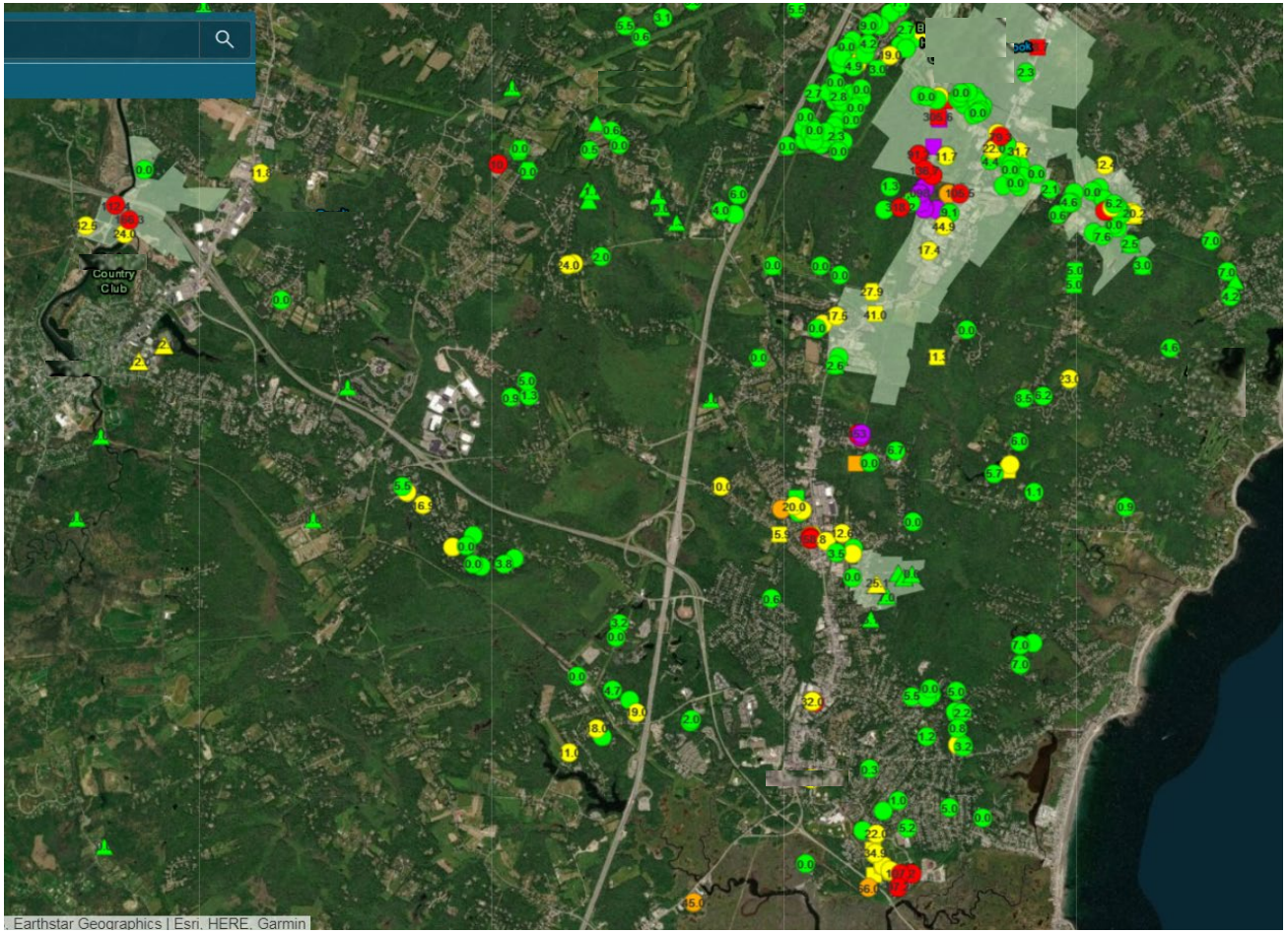
Surface Water Samples in tributary PFOA = 12 to 51 ng/L

Non-traditional Source (Granite Processing Facility) Detention Pond Sample: PFOA = 22 to 73 ng/L

2015 study concluded that the results in tributary SW considered "insignificant" (2009 health advisory for PFOA = 400 ppt)

PFAS in Residential Wells

OVERLAP OF TRADITIONAL AND NON-TRADITIONAL SOURCES



PFASResults_GroundWater

PFOA+PFOS (ppt)

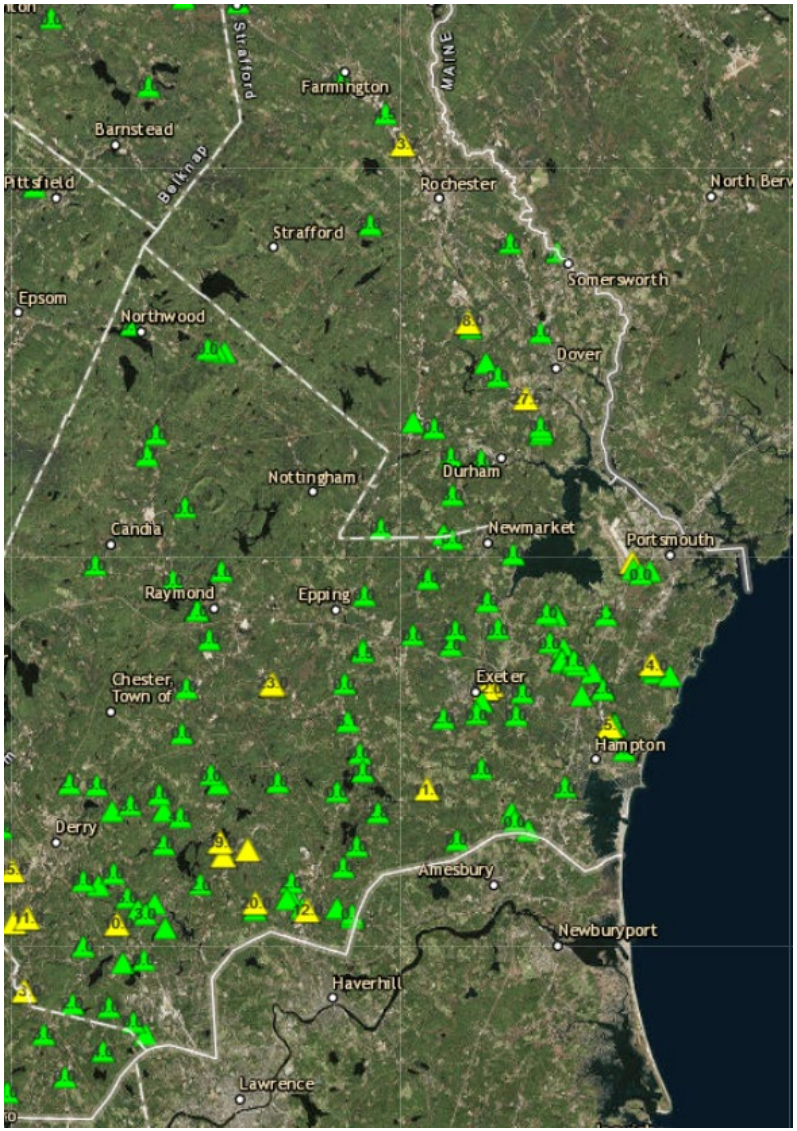
- 400+ ppt
- 70 ppt - <399 ppt
- 45 ppt - <70 ppt
- 10 ppt - <45 ppt
- <10 ppt

Source: http://nhdes.maps.arcgis.com/apps/View/index.html?appid=66770bef141c43a98a445c54a17720e2

PFAS and Water Supplies

NEW HAMPSHIRE RESULTS

- Public Water Supplies
  - Over 300 PWS sampled
  - At least 20 PWS had wells with results above 10 ppt
- Domestic well samples
  - Significant percentage of wells sampled had PFOA or PFOS above 10 ppt
  - Most common in areas with commercial or industrial development



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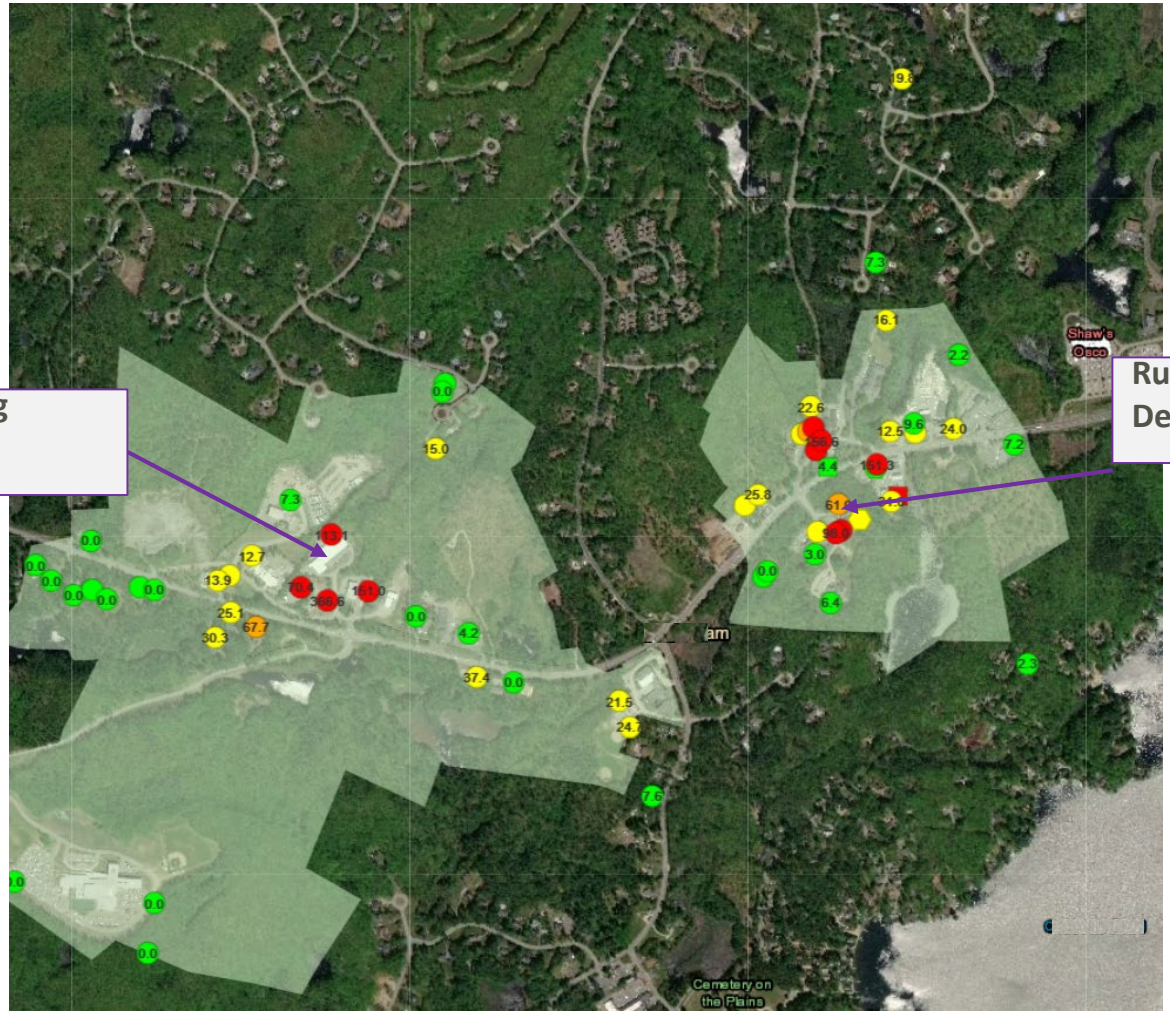
PFAS in Residential Wells



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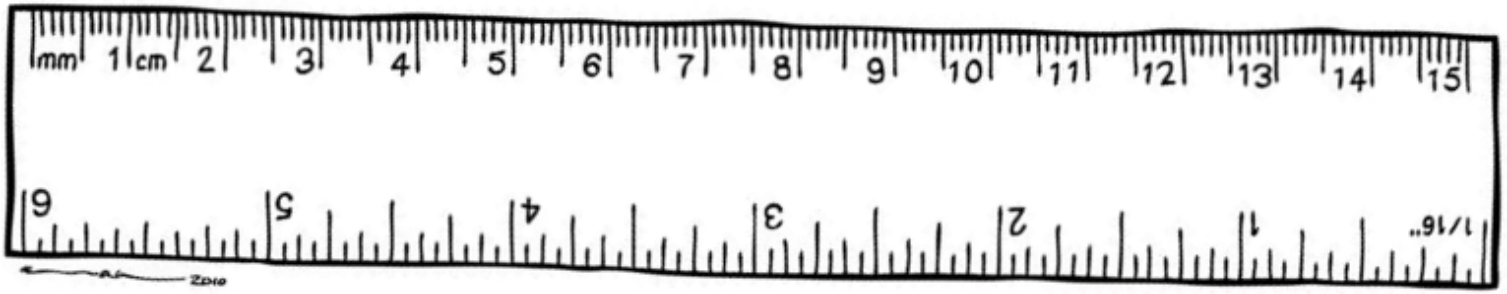
Source differentiation

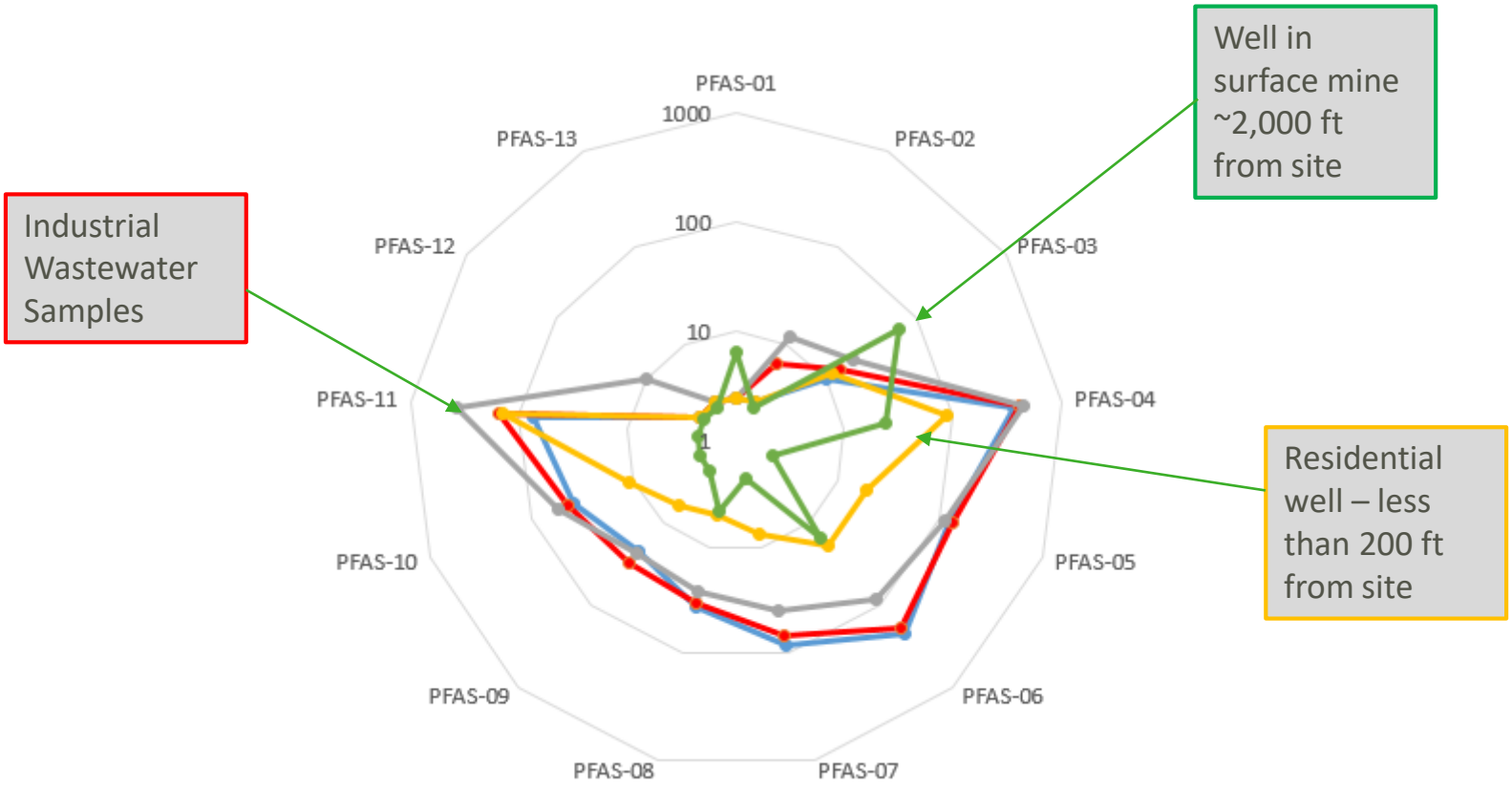
Industrial Wastewater Samples
PFOA ~1000 ppt

Residential well – less than 200 ft from site
PFOA ~100 ppt

Well in surface mine ~2,000 ft from site
PFOA ~25 ppt



Case Study 2 – Source Differentiation



Findings

- Non-traditional sources:
  - We are developing a better understanding of their role
    - Can result in significant PFAS impacts to multiple environmental media
    - Can comingle with impacts from traditional PFAS sources confounding assessments
  - Will become increasingly significant as states consider adopting lower enforceable standards
  - Should be considered in cost-benefit analysis during development of enforceable standards
  - Will complicate remediation and cost recovery
- Awareness and detailed characterization is critical

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